TABLE 4.1-1
THERMAL AND HYDRAULIC DESIGN

Reactor Core Heat Output, MWt	3459	
Reactor Core Heat Output, 10^6 Btu/hr	11,806	
Heat Generated in the Fuel, %	97.4	
Nominal System Pressure, psia	2250	
Assumed Initial System Pressure for DNB Transients, psia	2218	(STDP[1])
	2250	(RTDP[2])
Minimum DNBR for Design Transients	V-5H[3]	1.24 (RTDP)
	RFA[7]	1.24 (RTDP, Typ)
	RFA	1.22 (RTDP, Thm)
DNB Correlation	V-5H[3]	WRB-1
	RFA[7]	WRB-2
Coolant Flow		
Total Thermal Design Flow Rate, 10^6 lb/hr	125.3[5]	
Effective Flow Rate for Heat Transfer, 10^6 lb/hr	116.3[5]	
Effective Flow Area for Heat Transfer, ft^2	V-5H[3]	51.3
	RFA	51.1
Average Velocity Along Fuel Rods, ft/sec	V-5H[3]	14.1
	RFA	14.2
Average Mass Velocity, 10^6 lb/hr-ft^2	V-5H[3]	2.27[5]
	RFA	2.28[5]

TABLE 4.1-1 (Continued)

THERMAL AND HYDRAULIC DESIGN

Coolant Temperature	
Nominal Inlet, °F	542.7 (5)
Average Rise in Vessel, °F	70.4 (5)
Average Rise in Core, °F	75.2 (5)
Average in Core, °F	582.4 (5)
Average in Vessel, °F	577.9 (5)
Heat Transfer	
Active Heat Transfer Surface Area, ft^2	59,700
Heat Flux Hot Channel Factor, F_Q	2.40
Average Heat Flux, Btu/hr-ft^2	192,470
Maximum Heat Flux for Normal Operation, Btu/hr-ft^2	461,930
Average Thermal Output, kW/ft	5.52
Maximum Thermal Output for Normal Operation, kW/ft	13.3
Peak Linear Power for Determination of Protection Setpoints, kW/ft	$\leq$22.4
Peak Fuel Center Temperature at Maximum Thermal Output for Maximum Overpower Trip Point, °F	<4700

Fuel Assemblies	
Design	RCC Canless
Number of Fuel Assemblies	193
UO_2 Rods per Assembly	264
Rod Pitch, in	0.496
Overall Dimension, in	8.426 x 8.426
Weight of Fuel (as UO_2) in Core, lbs	STD, V5H, V+ 222,739 RFA[9] 217,565
Weight of Zircaloy in Core, lbs	All STD 50913 All V5H,V+ 52541 All RFA 53847
Number of Grids per Assembly	STD 8 Inconel V5H 2 Inconel (Top & Bottom) 6 Zircaloy-4 (Mid Grids) V+ 2 Inconel (Top & Bottom) 6 Zirlo™ (Mid Grids) RFA 2 Inconel (Top & Bottom) 1 Inconel (Protective Grid) 6 Zirlo™ (Mid Grids) 3 Zirlo™ (Intermediate Flow Mixing Grids)
Loading Technique	3 Region Non-uniform
Fuel Rods	
Number in Core	50,952
Outside Diameter, in	0.374
Diametral Gap, in	0.0065
Clad Thickness, in	0.0225
Clad Material	STD, V5H Zircaloy-4 V+,RFA Zirlo™

TABLE 4.1-1 (Continued)

THERMAL AND HYDRAULIC DESIGN

Fuel Pellets	
Material	UO_2 Sintered
Density, % of Theoretical	95.5
Diameter, in	0.3225 (10)
RFA Annular Pellet I.D., in	0.155 (11)
Length, in	STD 0.530 V-5H (3) 0.387 RFA Solid 0.387 RFA Annular 0.462 or 0.500 (12)
Rod Cluster Control Assemblies	
Neutron Absorber	Ag-In-Cd
Cladding Material	Type 316L Ionnitride Surface
Clad Thickness, in	0.0185
Number of Clusters	53
Number of Absorbers per Cluster	24
Core Structure	
Core Barrel, ID / OD, in	148.0 / 152.5
Thermal Shield, ID / OD, in	158.5 / 164.0
Nuclear Design Parameters:	
Structure Characteristics	
Core Diameter, in (Equivalent)	132.7
Core Average Active Fuel Height, in	143.7

TABLE 4.1-1 (Continued)

THERMAL AND HYDRAULIC DESIGN

Reflector Thickness and Composition	
Top - Water Plus Steel, in	~10
Bottom - Water Plus Steel, in	~10
Side - Water Plus Steel, in	~15
H_2O/U, Molecular Ratio, Lattice (cold)	2.41

(1) Standard Thermal Design Procedure.
(2) Revised Thermal Design Procedure.
(3) Also valid for V+ assemblies without Intermediate Flow Mixing Grids.
(4) Deleted
(5) For analyses where high average core temperature is bounding.
(6) Deleted
(7) With Intermediate Flow Mixing Grids.
(8) Deleted
(9) With annular axial blankets.
(10) Applicable to solid or annular pellets.
(11) Top and bottom 6" of RFA fuel stack height.
(12) Starting with Unit 1 Region 17 and Unit 2 Region 15.

TABLE 4.1-2

ANALYTIC TECHNIQUES IN CORE DESIGN

Analysis	Technique	Computer Code	Section Referenced
Mechanical Design of Core Internals			
Loads, Deflections, and Stress Analysis	Static and Dynamic Modeling	Blowdown code, FORCE, Finite element structural analysis code, and others	
Fuel Rod Design			
Fuel Performance Characteristics (temperature, internal pressure, clad stress, etc.)	Semi-empirical thermal model of fuel rod with consideration of fuel density changes, heat transfer, fission gas release, etc.	Westinghouse fuel rod design model	4.2.1.3.1 4.3.3.1 4.4.2.2 4.4.3.4.2
Nuclear Design			
1) Cross Sections and Group Constants	Microscopic data	Modified ENDF/B library	4.3.3.2
	Macroscopic constants for homogenized core regions	LEOPARD/CINDER type or PHOENIX-P	4.3.3.2
	Group constants for control rods with self-shielding	HAMMER-AIM or PHOENIX-P	4.3.3.2
2) X-Y and X-Y-Z Power Distributions, Fuel Depletion, Critical Boron Concentrations, x-y and X-Y-Z Xenon Distributions, Reactivity Coefficients	2-Group Diffusion Theory	TURTLE (2-D) or ANC(2-D or 3-D)	4.3.3.3
3) Axial Power Distributions Control Rod Worths, and Axial Xenon Distribution	1-D, 2-Group Diffusion Theory	PANDA or APOLLO	4.3.3.3

TABLE 4.1-2 (Cont)

Analysis	Technique	Computer Code	Section Referenced
4) Fuel Rod Power	Integral Transport Theory	LASER	4.3.3.1
Effective Resonance Temperature	Monte Carlo Weighting Function	REPAD	
Thermal-Hydraulic Design			
1) Steady-state	Subchannel analysis of local fluid conditions in rod bundles, including inertial and crossflow resistance terms, solution progresses from core-wide to hot assembly to hot channel	THINC-IV	4.4.3.4.1
2) Transient DNB Analysis	Subchannel analysis of local fluid conditions in rod bundles during transients by including accumulation terms in conservation equations; solution progresses from core-wide to hot assembly to hot channel	THINC-I (THINC-III)	4.4.3.4.1

TABLE 4.1-3

DESIGN LOADING CONDITIONS FOR REACTOR CORE COMPONENTS

1. Fuel Assembly Weight
2. Fuel Assembly Spring Forces
3. Internals Weight
4. Control Rod Scram (equivalent static load)
5. Differential Pressure
6. Spring Preloads
7. Coolant Flow Forces (static)
8. Temperature Gradients
9. Differences in thermal expansion
   a. Due to temperature differences
   b. Due to expansion of different materials
10. Interference between components
11. Vibration (mechanically or hydraulically induced)
12. One or more loops out of service
13. All operational transients listed in Table 5.1-10.
14. Pump overspeed
15. Seismic loads (operation basis earthquake and design basis earthquake)
16. Blowdown forces (due to cold and hot leg break)